THE MODEL ENGINEER

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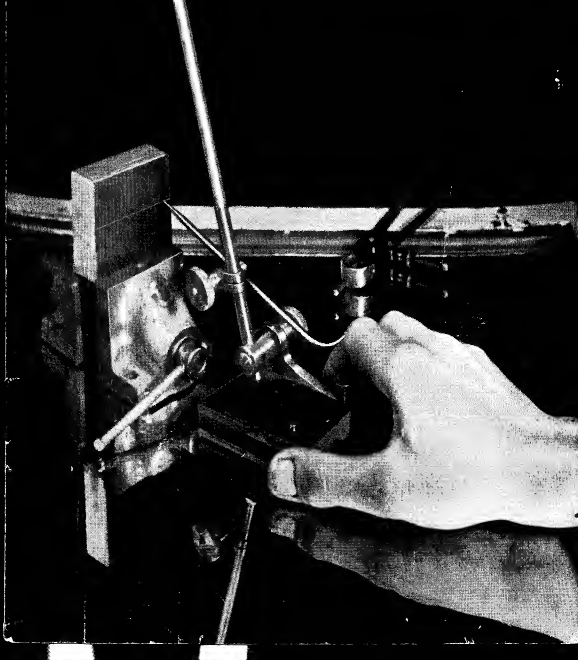


The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

28TH APRIL 1949 VOL. 100 NO. 2501

SMOKE RINGS

Our Cover Picture

● THE PHOTOGRAPH this week depicts the use of a mirror as a substitute for the usual surface plate. In this case it is being used for the marking of a piece of metal to be used for a small bedplate which is to be cut from the solid. A mirror has an advantage over the usual surface plate because it enables the user to check by the reflection when the rule used for taking off dimensions is truly vertical.

For accurate marking-off, scriber points should be sharp, and the surface prepared by coppering or painting with one of the numerous proprietory paints marketed for this purpose.

Mr. A. R. Turpin, who submitted the photograph, writes :—" Marking-off always gives me a thrill, as it is the beginning of something new, and I haven't come to the snags ; in fact, at this stage, I never expect any."

Northern Models Exhibition

● WE HEAR that the exhibition organised by the Northern Association of Model Engineers' and recently held in Manchester, was a great success, attracting some 10,000 visitors. Our representative reports that the exhibits, which covered almost every phase of model engineering interest, maintained a very satisfactory standard of workmanship.

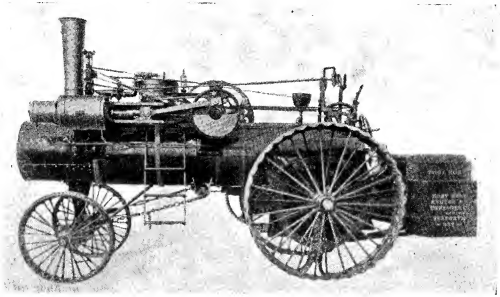
The Championship Trophy for the best model in the competition section was donated by Myford Engineering Co., Beeston, and awarded to Messrs. A. A. and C. W. Verity, of Bramhall, for their splendid 2-in. scale Fowler showman's road locomotive. We hope to see this model at THE MODEL ENGINEER Exhibition next August.

A fine 2½-in. gauge 4-6-0 locomotive by Mr. R. S. Jaques, of Boston, carried off chief honours in its class and fully deserved the award. Among the small-scale locomotives, Mr. R. D. Pochin, of Manchester, won first prize, with his delightful " O "-gauge L.N.W.R. 2-4-0 tank engine, while second prize went to Mr. A. F. Jackson, of Stockport, for his 4-mm. scale L. & Y.R. 0-6-0 locomotive. Although neither of these latter two won a major award, each was an outstanding example of its kind.

The " Hobbies " Cup for the best galleon was won by Mr. G. A. Williams, of Stretford, while Mr. Jaques gained another award by winning the Institute of Marine Engineers prize for the best model marine engine. The " Dick Simmonds Prize " for the best steam model, having regard to the tools and trade of the builder, went to Mr. W. Ogden for a 1¼-in. scale traction engine.

A Canadian Traction Engine

● TRACTION ENGINE enthusiasts may be interested in the photograph reproduced on this page. It is one of a number sent us by Mr. Charles Bedford, of Brixham, and it depicts a 17 h.p. tandem compound road engine built in 1907 by the Robert Bell Engine and Threshing Co., of Seaforth, Ontario, Canada.



We are interested to observe that, just as in the case of a Canadian or American railway locomotive, although the basic features are similar to Britain's practice, the details and general appearance are strikingly different. For example, the construction of the wheels is not like any seen in British practice, and seems to have derived directly from the coach-builder's method, though in metal and not wood. The position of the cylinders is interesting and unusual, even for transatlantic road engines.

An Engineman's Proposed Club

● WE WERE very interested and delighted to receive a letter from a Western Region engineman, Mr. V. Chellingworth, to inform us that he had been asked by numerous employees to form a club at Old Oak Common Locomotive Depot. We have always known that model engineering is popular among railwaymen, many of whom are readers of THE MODEL ENGINEER; but we do not, for the moment, recall that a club has been formed before exclusively within, or attached to a locomotive depot. Old Oak Common is more than a running-shed; it is the London headquarters of the Western Region Locomotive Running Department, and it is the principal Locomotive Repair Depot in the London Division of the Western Region. There ought not to be much difficulty in finding among its personnel many men who would be keen to be members of a model engineering club, and we hope that Mr. Chellingworth's scheme will not only materialise, but enjoy many years of prosperity. We also hope to hear more of it, and others like it, from time to time.

The Birlec Lectromelt Furnace

● MESSRS. BIRLEC LTD., of Birmingham, have written to point out an error in the description of the model which was the subject of our cover picture for the April 7th issue. The description states that the electrodes are of copper tubing, "as in the original," whereas, in the actual furnaces, the electrodes are made of carbonaceous material.

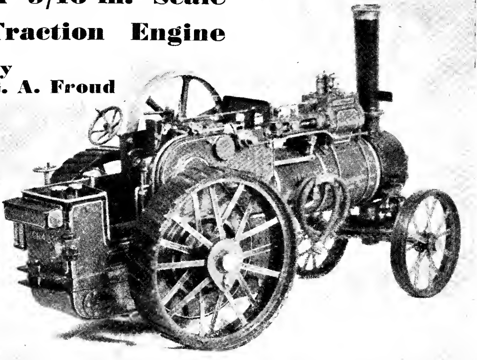
We are interested to learn that Messrs. Birlec's engineers have electrified the model to show all movements, and it will be on view at the British Industries Fair, Castle Bromwich, May 2nd-13th. Those of our readers who are visiting the Fair should make a special effort to see this interesting model.

Dursley Model Engineering Club Saved

● WE WERE very glad to receive a letter from Mr. A. W. Jones to inform us that, as a result of the publication of the paragraph headed "Urgent Appeal" in "Smoke Rings," March 10th issue, the membership of the Dursley Model Engineering Club at the local Technical Institute has increased from five to twelve. This, indeed, is excellent, and we extend our good wishes to the club, trusting that it may now enjoy a long period of uninterrupted prosperity. We hope, too, that progress in the construction of the club's $7\frac{1}{4}$-in. gauge "King George V" locomotive will be steadily maintained until the engine is completed. We would like to hear more about this ambitious project.

A 9/16-in. Scale Traction Engine

by G. A. Froud



TO many readers of this article I may seem a crank, to make a model to this unusual scale ; but let me tell you how this came about. When I started to make my first model traction engine many years ago, soon after the 1914-18 war, I started with a piece of $1\frac{1}{2}$-in. diameter tube for the boiler and so built the engine around this. Sad to relate, this model has never been completed. However, about 1936, the model bug bit me again in the shape of road vehicles.

I decided to make another traction engine, the same size as the previous one, which worked out to a scale of $\frac{9}{16}$ in. to the foot. The first item I made was the chimney, and then worked back, smokebox, cylinder, hornplates and so on. Some readers may think this unusual, but maybe I am an unusual person.

When I was drilling the steamways in the cylinder I had the misfortune to drill one of the holes straight through into the bore of the cylinder. However, to save scrapping hours of work, I opened up the bore to $\frac{1}{16}$ in. larger in diameter, slotted the steamways in the bore and then fitted a bush liner into it, thus leaving the correct shape of steamways in the cylinder.

My next trail of woes was the crankshaft. I scrapped three before succeeding with the fourth. It is made from the solid, the diameters of the journals and crankpin being only 5/32 in. The first one very quickly doubled up in the lathe, while the second, although I was more careful, eventually shared the same fate as the first. The third time, never like the rest, I left the portion for the crankpin solid for the final operation, and then I very carefully sawed the metal away to leave the crankpin. Lo and behold! I had sawn through the crankpin ; and so to the fourth! This occupied about five weeks of my very limited spare time.

All the rivets are 1/32 in. diameter in the shank. These were made from copper and brass pins, which had a very large diameter head, and were turned down to the standard rivet-head dimensions. In all I turned about 700 rivet-heads.

The hornplates have the correct number of rivets in them. I know this is correct as I have counted them on the full-size job. It is surprising to find how many there are. By the way, so many good models of traction engines are very poor in this respect, as some have a few rivets while others none whatever.

The road wheels are built up in the usual manner, except that the spokes are not separate. These were cut from a mild-steel disc thus leaving the centre solid with the spokes. There are 188 rivets in each rear wheel.

The safety-valve is similar to a Ramsbottom valve, except that the spring is in compression, being held down with a tension rod. I found this method was very satisfactory and there was no chance of so small a spring pulling out at the eye-end.

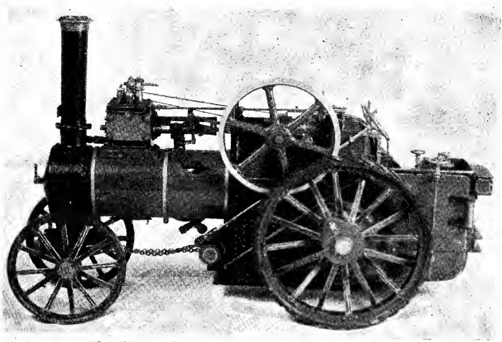
The Stephenson link-motion caused many headaches before it worked smoothly. Patience won, however, and now if running forward or in reverse, it will notch up satisfactorily.

The transmission is of two-speed type, with gearing between the hornplates, and a bevel-gear differential on the axle. Two crown-wheels and three pinions are used for this. The rear axle has a winding-drum which is free to rotate on the axle and is coupled to the axle with a bolt-lock.

A band-brake drum is attached to the left-hand wheel and is operated by a hand-wheel on the side of the tender.

Some of the details on this engine are solid and pulley on the outside of the crankshaft and over two jockey pulleys. I adopted this method owing to the difficult job it would be to join up a belt so small if the pulley for driving had been between the bearings.

My workshop-cum-garden-shed has not sufficient room to swing the proverbial cat around, the machinery department comprising a 3-in. lathe, treadle drive, and two hand power bench drills.



Near side view, showing steering gear, link motion and hand brake

only go to make up the "blobs and gadgets." Owing to their small scale, I found it next to impossible to get them to function, such as trying to encourage water to pass through $\frac{1}{16}$-in. diameter copper pipe. The head and rear lamps were made to burn a light, the lamp body being made from solid brass. The chimney-piece is detachable and a separate oil well, which will hold about three drops of oil and burns with a $\frac{1}{16}$ in. high flame for about twenty minutes, has a removable burner. However, nothing on earth would induce nature to co-operate when the lamp was assembled. I had to be content with one more "showpiece." These lamps are only $\frac{7}{16}$ in. high.

The boiler has three water tubes fitted into a downcomer on the backhead and is fed by a hand-pump fitted inside the tender. The spirit fire, which is a three-burner lamp, is controlled by a hand-wheel in the bunker. A blower valve is fitted on the backhead. The governors are driven by bevel gears whose outside diameter is 0.160 in. These have 20 teeth in each and look very realistic when running with the balls swinging out as the engine speed increases. The drive to this is unorthodox, being from a

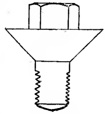
No castings were used on this model, the flywheel and other small hand-wheels are cut from solid.

When I first started on this model I adopted the 10-B.A. countersunk head screw as universal for the job; but alas, these screws, with their large screwdriver slot, did not look quite the thing for traction engines, so the design office had to do some more thinking. I made special 10-B.A. screws with a countersunk head and a hexagon on the top, the hexagon being only 0.077 in. across the flats. This method filled up the offending countersink and gave an almost scale-size bolt-head with the additional strength of a countersunk head.

The water-hose is made from a piece of cycle valve rubber and has a strainer at one end and screwed union at the other. It is bound with 0.007 in. thick brass wire, which I managed to do by putting the valve rubber over a cycle spoke, holding one end of the spoke in the lathe chuck and running the brass wire on through a guide in the lathe tool-post.

Gear making was an interesting job. I converted the compound top slide of my lathe into a

small shaping attachment, and with a lathe tool ground to the appropriate shape of a gear tooth; with this laid on its side, gear shaping became fairly easy. The dividing was obtained by using one of the lathe change-gear wheels as a ratchet-wheel and driving this through a suitable gearing to obtain the necessary number of teeth required. Bevel-gear teeth were cut by setting the top slide of lathe to the angle required.



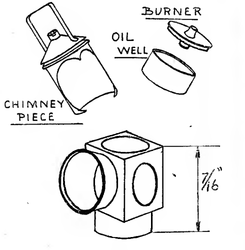
Special countersunk-head screws

The hand-pump for the feedwater is operated by an up and down motion with the small handwheel, seen in the centre of the tender. In spite of the small size of the pump it will lift half a pint of water in one minute.

The overall length of the engine is 10 in.; the diameter of the road wheels are, for the rear $3\frac{9}{16}$ in. over strakes, the front $2\frac{3}{8}$ in.; flywheel diameter, $2\frac{7}{16}$ in.; the height to the top of the chimney is $6\frac{3}{8}$ in. The cylinder has a $\frac{3}{8}$ in. diameter bore and $\frac{1}{2}$ in. stroke.

The two-speed gear has a top gear of $13\frac{1}{2}$ to one; bottom gear is 22 to one.

The rims of the rear wheels are made in three pieces, the outer diameter is made from a piece of 3-in. diameter × 16-gauge tube. This being too thick for the job, I therefore bored it out in the

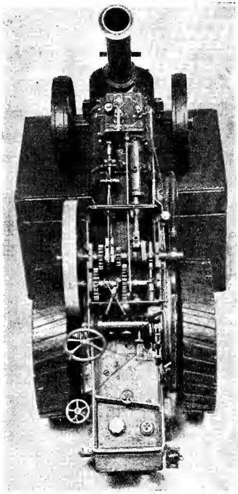


An exploded view of driving lamps

lathe to 1/32 in. thick. I had to operate this very carefully to avoid buckling the tube. The T-section of the rims is made from T-section brass bar, bent to a circle and turned over the top. These were then sweated, with the aid of the kitchen cooker, into the thin outer sleeve and finally put up in the lathe and bored out to scale dimensions.

The 0.077-in. hexagons on the heads of screws were machined in the lathe, using an end-mill in the chuck and holding the screws in a dividing-head fixed to the lathe saddle. The dividing-head is of my own design and make. The dividing for the hexagon was obtained by using a 60-tooth change-gear wheel.

In this model I have endeavoured to keep as true to scale as possible. A photograph taken in a true setting should give no clue to what size

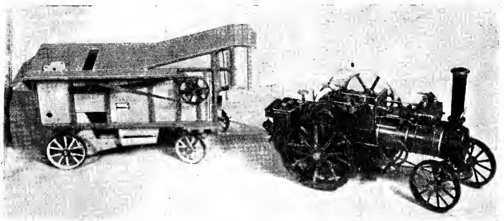


Bird's eye view, showing machinery and controls. Note hand pump wheel in centre of tender

this engine is, however, I leave this to the reader's criticism, which I value very much.

The work on this model occupied my leisure hours for about ten years, apart from having to put it aside during the worst war period. The majority of the winter work was done on the dining-room table, which bears the scars to this day!

Apart from the small scale, the engine will run smoothly, with a tick-over on a fraction of throttle, or race like a scalded cat when opened

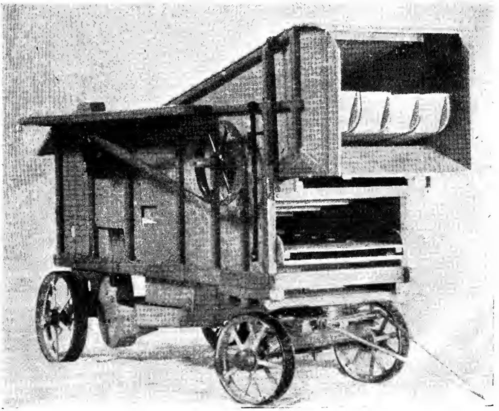


Waiting for a scale-size driver !

full out. At Vickers Model Show it was running for seven hours non-stop.

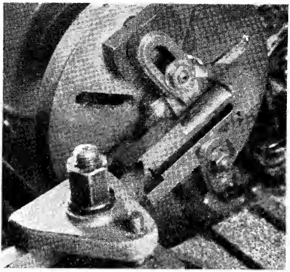
The threshing-machine is the same scale as the engine and is now under construction. At some later date, with the Editor's permission, I hope to give details of this machine.

A final word: a large number of builders of model traction engines make their rear wheels with the spokes riveted to the outside of the rims. So far, I have not come across any make of road engine that uses this method. So many otherwise excellent models are spoiled by this error ; but maybe I am wrong. Perhaps some readers can give information on this.



* A Universal Swivelling Vice

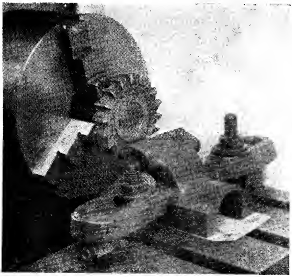
by "Ned"



Facing the undersides of fixed and sliding jaws simultaneously

ONE or two minor modifications have been made to the component details of the vice since the original one was constructed, and this will account for the fact that the photographs and the drawings do not correspond exactly in all respects. With regard to the materials used for construction, it is recommended that the main components of the vice itself—that is to say, the fixed and moving jaws, and the soleplate with its integral ball, should be made in cast-iron, as there is no material quite equal to this in wearing properties, and few equal to it in essential strength. It is, however, possible to use a more easily machinable metal for the base stand if desired, and this will be discussed further when dealing with the machining of the component in question.

*Continued from page 460, "M.E.," April 14, 1949.



Milling the rebate of the fixed jaw

Fixed Jaw

In order to facilitate the boring of the tunne which forms the sliding way for the other jaw, an extra piece of metal is cast on the underside of this component, so as to allow of producing a completely circular bore, which is obviously much easier to machine, especially in respect of accurate finishing operations, than an interrupted surface. The surplus metal is afterwards sawn off, prior to machining the flat surface of the underside.

The boring is carried out with the casting held in the chuck by the rear end, with the jaw face outwards, and no marking out is necessary beyond locating, as accurately as possible, the centre of the bore, with reference to the external unmachined surfaces. Set the casting in the four-jaw chuck, to run truly on the bore centre, axially true on the sides and top, and square on the jaw face. Bore out with a rigid tool to a few thousandths of an inch under $\frac{7}{8}$ in. diameter, after which the bore may be finished to size with a floating cutter or a reamer, if available. The former is generally preferable, and is one of the tools which the amateur can make for himself without much difficulty. Should a reamer be used, it should only be required to take out the bare minimum of material, a mere scrape in fact, or the resultant bore may be more nearly polygonal than circular. For a really high precision finish, lapping may be resorted to, and this method is recommended for the worker who has neither a reamer nor any other form of sizing tool, but plenty of patience.

While the casting is set up, the face of the jaw can be machined, and it is also

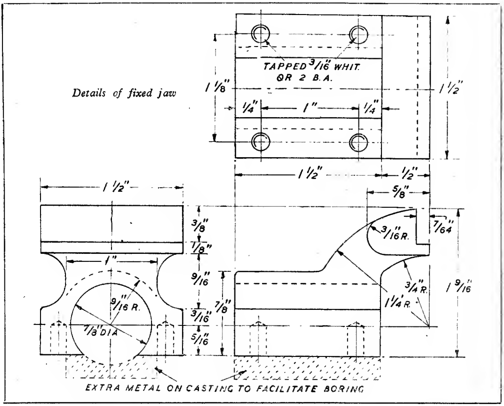
possible to rough out some of the material in the rebate for the jaw insert, if desired, to save subsequent work in machining or filing this surface. It is not desirable to cut away the surplus metal on the underside until the moving jaw has been turned to fit the bore of the tunnel.

Moving Jaw

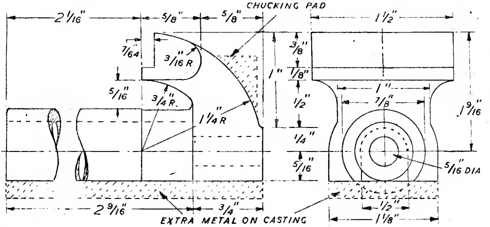
The ram of the jaw is cast integral with the jaw itself, and although this makes machining somewhat more difficult than when the ram is made separate, it was thought that no method of joining the two parts, with the possible exception of welding, would provide quite the same rigidity as making them in one piece. This casting is also held in the four-jaw chuck, with the jaw facing outwards, and in order to facilitate holding it in this way, a pad is cast on the front of the jaw to provide a suitable surface for the engagement of the chuck jaw on this side. In the absence of this pad, the casting may be found rather difficult to hold properly in the size of chuck usually available to model engineers. After machining, the pad may be sawn off and the surface of the jaw filed down flush at this point, though its presence is no real detriment for practical purposes, and is only objectionable on the score of appearance.

The ram of the jaw is cast solid, as it is generally easier to drill out from whole metal than to bore out a comparatively small cored hole. Another point is that the solid end allows of centre-drilling for support by the back centre. When setting up, care should be taken to see that the relieved portion of the ram, close up to the jaw, runs as truly as possible. The outside diameter is then turned dead parallel and to an accurate fit in the bore of the fixed jaw; it is best to concentrate on making it a light press fit at this stage, as it can quite easily be eased to a sliding fit later on. Apart from other advantages which will appear later, this enables the ram to be utilised as a mandrel to mount the fixed jaw for facing the rear end—not a vitally essential operation, but desirable from the aspect of conscientious workmanship.

Details of fixed jaw



After turning, the centre hole may be drilled and bored out to $\frac{5}{8}$ in. diameter, up as far as the jaw base. Unless one can be sure of accuracy in deep drilling—not always practicable with castings, as the tiniest blow-hole or patch of porosity will throw the drill off its true axis—it is not advisable to drill right through for the bearing of the vice screw at this stage. Although the $\frac{5}{8}$-in. hole is only a clearance for the loose nut, it will pay to bore it as truly as possible, and the end of this bore should be finished to a square face, either with the boring tool (which is not always easy in a deep bore) or with a flat-ended drill or facing cutter.

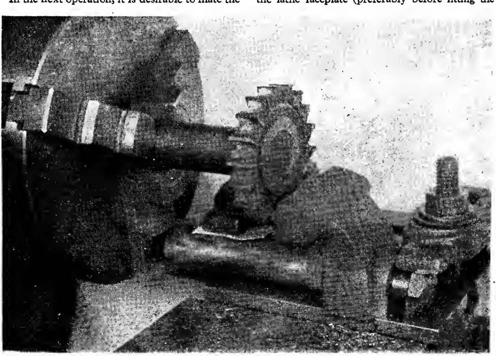


Sliding jaw, with integral ram

The casting may now be removed from the chuck, and rechucked truly over the end of the ram (use a strip of thin sheet metal wrapped round it to protect the finished surface) for facing the outer end and drilling and reaming the screw bearing. An alternative method of holding it for this operation is to turn a pin mandrel in the chuck, to fit the bore of the ram ; this will ensure positive concentric accuracy and save the trouble of meticulous setting up.

Facing underside of Jaws

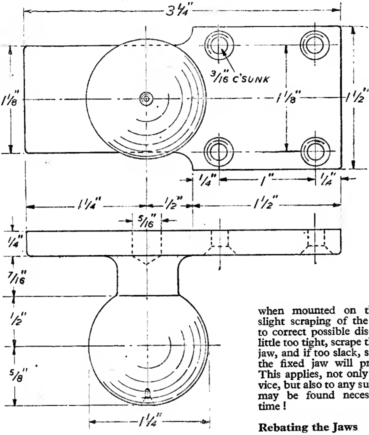
In the next operation, it is desirable to mate the two jaws in their working juxtaposition and machine them together. The surplus material on the fixed jaw is first removed, but though there is also extra metal on the ram and the base of the moving jaw, only the latter will have enough left on it to justify the use of a saw before machining the surface. Press the jaws together, so that the faces are in contact, and file or machine the top edges to coincide exactly, and provide a flat surface not less than about $\frac{1}{8}$ in. wide on each jaw. The jaw faces are now separated by an inch or so, and the assembly is then clamped to the lathe faceplate (preferably before fitting the



Milling the rebate of the sliding jaw. A bolt is inserted in the screw bearing to facilitate clamping down at this end

latter to the mandrel) with the top edges of the jaws resting against it, and clamped over the necks of the jaws. It will be possible to hold the work quite securely by using two toe clamps, one on each side of the jaws, with small bridge pieces to span the jaws. In the case illustrated, the bridge pieces were made from odd bits of laminated bakelite board (Paxolin or Tufnol, for instance) which were filed to fit as snugly as possible to the curved surface under the "chin" of the jaws, and the resilience of this material affords an excellent grip. The concentric setting of the work is of no vital importance, and it may be centred roughly by eye, but a check should be made over the machined surface of the ram, using a scribing block on the faceplate, and the bent end of the scriber, to ascertain that this is exactly parallel with the plate, and thus square with the lathe axis when the latter is mounted on the mandrel. In the event of any error in this respect, correction may be made with thin metal or paper shims interposed under one or other of the vice jaws.

The undersides of the jaws may now be faced simultaneously, running the lathe on its slowest backgear speed and using a rigid, and properly set, round-nosed facing tool. Take fairly light cuts to avoid risk of shifting the work; this is one of the operations when the slogan should be *Festina lente*—or in plain English "Make haste slowly." This care will be repaid eventually by the production of a flat surface which will be accurate within very close limits, and ensure that both the jaws have exactly the correct amount of metal removed from the underside to fit perfectly when mounted on the soleplate. Only very slight scraping of the surface will be necessary to correct possible discrepancies; if the fit is a little too tight, scrape the underside of the moving jaw, and if too slack, similar treatment applied to the fixed jaw will produce the desired result. This applies, not only to the initial fitting of the vice, but also to any subsequent reservicing which may be found necessary—in about 50 years' time!



Soleplate, with integral ball member

Rebating the Jaws

It is quite practicable to use the vice for light work without jaw inserts, or with facings screwed to the unrelieved jaw faces, but the orthodox method of rebating the jaws to locate the insert has obvious practical advantages. The rebates may be cut by a simple milling process, mounting the jaws in turn on the lathe cross-slide, and running a cutter in the lathe chuck; this, of course, assumes that the constructor does not possess a milling machine or shaper.

In the case illustrated, a side and face milling cutter of suitable diameter happened to be available (thanks to that modern Santa Claus, the Ex-Government Surplus dealer!) and was therefore used for the job; but it could have been done just as accurately and effectively, though somewhat slower, by a simple single-point fly-cutter such as has often been recommended for such operations. Great care is necessary to ensure that the cut is taken exactly

parallel to the originally machined jaw face, and the best way to make certain of this, when setting the work on the cross-slide, is to clamp a rigid straightedge to the jaw face (a length of ground tool steel about 9 in. long was used in this case) and with the lathe faceplate in position, take measurements between the surfaces at extreme points front and back. The width of the rebate in a horizontal direction should be a little less than the finished thickness of the insert it is intended to use, and its depth $\frac{3}{8}$ in. from the top surface of the jaw; but this dimension is not critical, as it is usually possible to trim the top edge of the insert in position before hardening.

Soleplate

The casting should first be held in the four-jaw chuck, by the ball, with the flat surface set to run axially true, for facing the latter as accurately as possible. Do not drill the recess for the loose nut at this stage. It is then reversed, and held either in the inverted jaws of the chuck, or clamped flat against the faceplate, for facing the underside and roughing out the surface of the ball. The outer end of the casting may be supported by the back centre during this operation. In order to obtain the maximum strength and rigidity in the mounting, an ample fillet should be left at the root of the ball.

Shaping the Ball

In the roughing process, the ball may be shaped within not more than $\frac{1}{16}$ in. of its finished size, and the initial procedure should be first to face the end to within this amount of the specified distance from the flat surface, and then turn the diameter also to the same limits. A good deal of the remaining surplus can then be machined away by judicious manipulation of the lathe slide-rest, and the use of a rough template or radius gauge will be found helpful in this respect. It is a matter for care rather than outstanding skill to turn the ball roughly spherical, but obviously the error should always be kept on the full side. A groove in the finished surface of the ball would not necessarily spell disaster from the practical point of view, but it certainly looks bad!

The next stage in the procedure consists of making a very simple lathe fixture which will enable a true spherical curve to be generated, and put the accuracy of the ball beyond any possible doubt.

(To be continued)

A Gas-Heated Soldering Iron

MESSRS. A. W. GAMAGE LTD., have submitted for our inspection a sample of the "Aeromatic" industrial soldering iron, which is gas-fired, self-blowing, and can be operated from the domestic supply, the fixed air supply being drawn through two venturis in the barrel, and the resultant gas air mixture causing a ring of flame to impinge on the heel of the bit. On test, this ring of flame was short and comparatively fierce, and it was found that partial restriction of the air inlet holes enabled the blue cone of flame to touch the heel of the bit. In view of this, it is considered that an adjustable air supply of the Bunsen burner type, would be an improvement. The model tested weighed 1 lb. 10 oz. complete and was fitted with a screw-on detachable straight bit which accounted for 12 oz. of the weight. Alternative bits are available. This iron behaved well in all positions, except when inverted, there being a tendency to pop back in this position. An on-off cock is fitted to the base of the hand-grip with a teat adaptor for rubber tubing. This cock, apart from its on and off positions, is of little value as a flame regulator. The use of a gas-heated iron not only avoids the delay and inconvenience entailed in reheating a plain bit, but also shows advantages over an electric iron when dealing with continuous work on heavy sections of metal.

The "Aeromatic" soldering iron

Legal Liability and Passenger Tracks

by "Lex"

A FEATURE, indeed often *the* feature of Exhibitions, Galas, Flower Shows, and what have you, is nowadays a model passenger track, usually provided and run by a local Society of Model Engineers. Thousands of children are carried on it, and very few accidents happen. The Society running the track almost invariably takes every possible precaution to avoid accidents. But in fact, very few members, or even officials of societies have any clear idea of what their liability may be, and in what circumstances it may arise. That being so, it is thought that the following notes may serve to give those concerned a necessarily brief outline of the responsibilities of a society in these circumstances.

First of all, who, if anyone, is liable ? Usually, a Society is not formally incorporated as a limited company, and is merely a number of persons not recognised at law as making up a separate entity. Occasionally, the rules provide that members are liable to indemnify the committee in respect of all liability arising out of their duties. More often this is not so, and in that case, it is often very difficult to decide whether an ordinary member is responsible at law for a liability arising out of some agreement or arrangement. That this liability may be substantial is shown by the case of Brown *v.* Lewis, where the members of a committee of a football club who had employed an incompetent person to repair a stand, were held personally liable for damages to a member of the public injured by its collapse.

Roughly speaking, the following may be taken as a sound working rule.

The funds of the club are liable for all responsibilities of the club. In addition, the members of the club concerned in a matter, all members of a committee who have approved it, or, without express approval, have consented to or acted on it, and all members present at a meeting at which the matter has been discussed, may come under personal responsibility if a legal liability arises out of that matter against the club. A member who has taken no part in the matter, and has attended no meeting at which the matter was discussed, and has not expressed to the committee of the club his approval, will not be under personal responsibility unless the club rules expressly so provide.

At this point, it may be as well to point out that in the case of a club function, everyone concerned with the running of the function is, while doing so, acting as the club's agent. In consequence, the club is liable for the acts of engine drivers, ticket sellers and the "black gang," carrying coal and water. Also, the locomotives, though the property of individual members are, while running at the function, under the control of the club and the club is responsible therefor.

Having briefly dealt with the question of who, in the club, may be liable, it is necessary to consider to whom the club may be liable. It should first be explained that there is no absolute duty to insure safety. The club is not liable for an accident which nothing could have prevented, an Act of God. Its duty is to take care to avoid damage to others and the degree of care required, varies with the relationship between the club and the person concerned. It is therefore necessary to distinguish between the various classes of persons who may be injured. There are five of these classes :—

(1) Members of the club.
(2) Trespassers.
(3) Licensees—or guests of the club who pay nothing for their presence on the track and are merely there on pleasure.
(4) " Invitees "—a not very happy word implying a person who—while not paying for his presence—is more than a mere social guest, but is there on some business concerning the club. A prospective member, a reporter or a visitor discussing arrangements for future use of the track, would come within this category.
(5) Persons paying for use of the track as passengers.

As regards members of the club, the position is simple. The club is not under liability to them for they are part of the club and cannot sue themselves, but they may have rights against fellow members if such members by negligence cause them damage. A club member cannot sue the club if the track collapses while he is on it, but if he can prove that the collapse was due to the carelessness of another club member, say, in erecting it, he could sue that other member.

As regards trespassers, again the position is simple. The organisers of a track are under no duty to trespassers, except not to do something that is obviously dangerous to them. So the club is not liable if a trespasser, adult or child, gets on to the track, and burnt himself on an engine in steam. But the club would be liable if a driver, knowing a trespassing child was playing on the track, drove down recklessly and struck the child ; and if steps are not taken to keep trespassers clear, it may be held that the club has consented to their presence and that they have become licensees. Also, it must be remembered that in the case of children, the law will presume a licence to go on land more easily than in the case of an adult. So it is particularly important, even at the risk of being considered hard-hearted, to keep children outside the area of the track.

The next class is the class of licensees. This is probably the most usual case. It covers the ordinary guest at a track meeting, and in fact, every social visitor will be a licensee. Two points, whoever, are worth mentioning here. If someone—say a club member—is using his loco on the track, otherwise than at a club function, and brings guests along, or gives a casual ride to

by-standing children, then as regards the club, these guests will be licensees, and the club will be liable to them in respect of the condition of the track, though not, in this case, of the loco, for that is not under the club's control. Secondly, in the fairly common case where a club is invited by some organisation to put on a show and gives rides free in exchange for some benefit—monetary or otherwise—from the function, then it seems that the visitors to the show are not merely licensees but "invitees," and the club is therefore under a higher degree of responsibility.

Licences

However, as regards licensees, they normally must take the track as they find it, and accept the obvious risks. But the club is responsible for damage arising through concealed dangers known to them, but such as no normal person would expect. So a licensee—of full age—cannot complain if he burns his fingers on an engine's boiler, or nips them in the motion work, for those are obvious risks. But he is entitled to assume that the boiler will not burst, and that the brakes of the trucks will act, for these are conditions which cannot be checked by the man in the street; and unless the club can show that they were not aware of such danger (and here the member's knowledge is the club's knowledge), they will be liable. And it should be noted here that, in the case of children, the law recognises that some things are especially attractive to them, and have dangers which they are too young to appreciate. So liability has been held to arise for damage caused to children having access to a railway turntable (Cooke *v.* M.G.W.R.) or to poisonous berries. It will be appreciated that models are, if anything, even more attractive than those just mentioned. Moreover, a looker-on at the track from behind the barrier is still, as regards his position there, a licensee, and if a child can lean over and touch an engine in steam a claim may again arise.

So, to summarise, as regards licensees the club's liability is in respect of hidden damages which they know of, but which, whether by unfamiliarity or age, a licensee would not suspect.

Now as to invitees, this word is used legally to cover a rather mixed bag, whose common feature is that they are not mere guests on the one hand, or paying passengers on the other, but persons whose visit is connected with the club. Thus customers of a shop or workmen coming to repair premises are both invitees. The people who are most likely to be comprised in this class have already been mentioned; but, in any case of doubt, it is probably safer to assume that anyone whose presence is due to any degree by the business of the club is an invitee—and this will include volunteer helpers from outside the club.

The liability to an invitee can be summarised that he, using reasonable care for his own safety, is entitled to expect that the occupier shall use reasonable care to prevent damage from unusual danger of which he knows, or ought to know. Here, it will be seen that the club cannot claim ignorance of the danger as a defence, unless it can be shown that there was no neglect on their part. The question of whether the club has taken reasonable care is, in every case, a matter of fact—to be proved by evidence; and it is consequently very desirable that precautions, such as track levelling, boiler testing, etc., should not only be taken but should be taken methodically and systematically, so that they can be proved. Obviously, also an untried locomotive, truck, or track should never be put into service without such a test.

The last class, and the class which has the highest rights, is the paying passenger. His right is to have premises as safe as competent care and skill can make them, and this means not only the club's care, but the care of everyone concerned. So if the club, in testing boilers, relied on a new pressure gauge, bought from a reputable maker, but is nevertheless defective, that might be a good defence as regards licensees and invitees; but in the case of paying passengers, it would be of no avail, for the club would be responsible for the negligence of the gauge makers, and whether the club could claim indemnity from them would depend on the circumstances of each case. It is only in the case of defects which could not reasonably have been detected by anyone that any relief arises.

This sweeping liability is, however, modified by one provision which, while hard to describe in words, is, nevertheless well established. The club is not responsible—even to paying passengers, for the normal risks of the game. So a cricket club is not liable to a spectator who is hit on the head by a ball going for six. In the case under consideration, however, this is not very helpful, but it would probably operate in the case of a person burnt by a spark from the engine.

Negligence

So far, we have been discussing the position largely as regards accidents that "just happen." But, of course, accidents can also happen through positive negligence. A driver fails to apply the brakes, or takes a corner too fast, and damage occurs. In that case, as already mentioned, he is an agent of the club, and his acts are the club's. It is, of course, only reasonable that the club should be responsible for the instruments, human or mechanical, with which it carries out its functions, and liability may arise equally from a defective truck or a negligent driver. The standard of care and skill which the law requires in a case, such as this may be, involving a special knowledge and skill, is the care and skill of an ordinarily competent practitioner of the craft involved. So it is essential that, at public functions, only competent drivers should be used. But even the most competent man may slip, and the club and its funds will be liable for his negligence. It is, however, a matter of more doubt how far individual committee-men and members are liable personally in such a case, and it is at least arguable that a committee-man who has concurred in the appointment of a competent driver, but has taken no part in the actual management of the affair, will not be liable for the unforseeable lapse of the driver.

Having summarised the way in which liability

may arise, the question which logically follows is: for what consequences is the club liable. The answer is laid down in the case of *re* Polemis and Furness Withy Line, that the wrongdoer is answerable for all consequences actually arising from his wrong, whether or not they might reasonably have been anticipated. The liability will only cease when some new factor intervenes unconnected with the default. In the case mentioned above, a stevedore dropped a plank into the hold of a ship. The plank struck a spark and ignited some petrol vapour that had leaked into the bilges. The result was that the ship was destroyed. Although the Court expressly found that the consequences could not have been reasonably anticipated, they nevertheless held the firm of stevedores liable for the whole damage. Even apart from such unusual cases, it must be remembered that a model locomotive if mishandled has in it the potential power to kill or maim a person, and in such case, damages may well run into four figures.

It is, of course, possible for a club to limit its liability either to licensees, invitees or fare-paying passengers, by making a special contract with them. This contract could be effected by a notice clearly exhibited so as to be brought before all comers declaring that they entered upon the track in all respects at their own risk, and that the club did not in any way guarantee the safety of the track or the locomotives. Liability could also be limited by a suitable endorsement on tickets, provided the conditions were brought to the purchaser's notice—for in these cases, the tickets are normally surrendered forthwith and the passenger has little opportunity to peruse them. It may be questioned strongly whether such expedients are really in the interests of clubs, and whether they would not tend unduly to discourage use of the track. It may be said that the wisest course for a club is to accept its liabilicies and take steps to prevent accidents arising.

Lest, therefore, it be suggested that this article indicates many dangers, but shows no way of avoiding them, it seems desirable to set out what, from the lawyer's point of view, the club desirous of running a track in public should do.

First, some one person should be in charge, so that if any question arises, he may be able to prove exactly what was done. He should be given full authority. Secondly, before it is used for the public, the track trolleys, and every piece of equipment must be tried out, and the fact that they are in order reported to the "Chief Engineer." Thirdly, every locomotive must be tested for safety by a qualified man, such as a Boiler inspector, holder of a Board of Trade Certificate, or member of a recognised Engineering Institution. The certificate of this test should be in writing, and while it need not be repeated on every occasion when the locomotive goes into use, the full test should be repeated at least every three months, and the fact that the safety valves and gauges are in order verified each time the loco is steamed. Fourthly, only competent drivers should be allowed on public runs. The Chief Engineet must satisfy himself as to the competence of the driver.

Fifthly, before opening the track to the public, the Chief Engineer should satisfy himself that all the precautions listed above have been taken, that the enclosure is adequate for its purpose, that no one can lean over a barrier and get himself in danger, that there are no projecting nails or loose boards to cause accidents, and that no unauthorised persons have access to the track. He should also have a "dummy run" before loading up and can, at last start on the business.

The Chief Engineer has an unenviable job. He will, if he does his job properly, be considered a dog in the manger by the cheerful and casual type, who want to "rally round with a loco and lend a hand." But, if he is to do his duty by his club, he will have to insist that no loco, however impressive looking, is run without a proper test, and that no driver, however willing, drives unless he is satisfied with his competence.

All this may seem pernickety to the hardened and accustomed track wallah; but the lawyer is particularly interested, not in what precautions are taken, but what can be proved to be taken. If the worst comes to the worst, and an accident occurs, it is ten times as convincing to the Court if a clear record of what was done can be given than if it has to be explained that one man tested one loco, another man another, and that a third was let by on the owner's word. If, therefore, a system is adhered to and enforced, until it becomes a matter of habit, then not only will the possibility of accidents be reduced, but the club will be able to prove it has exercised all possible care and skill to avoid them.

Finally the club must insure against liability. Rates are not excessive if the rules set out above are strictly adhered to and, in any case, the possible liability of the club and its members is such that whatever the cost, it is worth doing.

For the Bookshelf

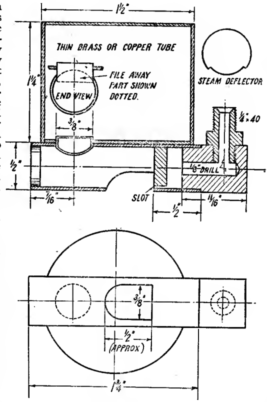
The Basingstoke and Alton Light Railway, by E. C. Griffith, B.A. (Farnham, Surrey: 23, Downing Street.) 28 pages, size 5½ in. by 8½ in. Fully illustrated. Price 3s. 6d.

One of the more modern of Britain's light railways, the Basingstoke and Alton line was opened in 1901 and closed in 1936. Its history is a fascinating one and is admirably told and illustrated in Mr. Griffith's little book. The line was of standard gauge and was worked first, by the London and South Western Railway and then by the Southern; its affairs during 35 years were varied and interesting, including being twice "commandeered" to provide background and venue for film stunts. All this is set out in detail by Mr. Griffith, and numerous photographs add much to the intrinsic attraction of the story.

A $3\frac{1}{2}$-in. Gauge L.M.S. Class 5 Loco.

by "L.B.S.C."

HERE, as promised is a description of a simple way of giving little "Doris" a voice that resembles that of her full-size relations. It is possible to get the exact note and timbre by means of a mouth-organ reed in a suitable tube, arranged in a manner somewhat similar to the old motor bulb-horn reeds; but it needs careful manufacture and adjustment, whereas the veriest Billy Muggins can easily make up the gadget shown. At one time, before the nationalisation business, the L.M.S. engines used to come past our hacienda every day, on the through run to Three Bridges; and if I happened to be out on the little railway, they would give me a friendly toot, though the clatter kicked up by the "8Fs" probably drowned the answering call of whatever engine I happened to be running. But I don't see them any more, and it is a far cry from here to the L.M.S.—it is nearly two years since I was anywhere near their home road; but there are plenty of "Austere Ada's" on this section, and they have a similar-sounding whistle, so I tuned up my experimental one to resemble their note.



Section and plan of deep-tone whistle

There is nothing new in the use of a resonator-box to obtain a deep note on a small whistle; Carson's used them on their $3\frac{1}{2}$-in. and 5-in. gauge engines 40 years ago. But there is one difference, which makes all the difference, in a manner of speaking; the Carson whistles were arranged vertically, with the box right on the end of a short tube whistle of the usual pattern. When steam was turned on, any water that went over, or any produced by condensation of the steam in a cold pipe, was blown up into the box, and kept there by the rush of steam, producing a "bobbling" sound. The whistle gave a clear note only when hot, and supplied with dry steam. One was fitted to the 5-in. gauge Carson "Precursor" which I did up for Mr. R. C. Hammett, when he put our air-raid shelter in, during the winter of 1940-41; this had the above characteristics. To get a clear note, you have to keep the water out of the "sound-box"; and the easiest way of doing this, is to use a short horizontal whistle with the sound-box on top of it. There is a simpler way still, and that is to put a short tube in the bottom of the sound-box, and blow a jet of steam straight across the end of it, by means of a "mouthpiece" having a very fine steam slot in it; but while this is certainly simpler "on paper," in actual practice it isn't, as the mouthpiece with the steam slot is rather ticklish to make and adjust. I tried one before making the gadget shown, and it took far longer, with more "messing about," and no better result. Incidentally, the first of this type I made, was for my L.B. & S.C.R. engine "Grosvenor"; and by using a sound-box $1\frac{1}{4}$ in. diameter and $1\frac{1}{8}$ in. long, the little engine has the voice of her big sister. When it first sounded on my road, I shouldn't have been the least surprised bit if the old Coulsdon signal had waved its arm in acknowledgment.

How to Make the Whistle

The sound-box is a piece of $1\frac{1}{2}$-in. diameter brass or copper tube squared off in the lathe to a length of $1\frac{1}{4}$ in. The gauge of tube doesn't matter within reason, but the thinner it is, the better. If a piece of tube this size isn't available, roll up a piece of sheet brass or copper, of about 22-gauge, and solder the joint. It need not be silver-soldered, or even riveted, as there is no heat or pressure to withstand. The two ends are discs of 22-gauge sheet brass or copper, cut to fit tightly, and soldered. At $\frac{3}{8}$ in. from the edge, on one of the ends, drill a $\frac{3}{8}$-in. hole.

The part that makes the noise is made from a piece of $\frac{1}{2}$-in. thin brass or copper tube, the ends

being squared off in the lathe, to a length of $1\frac{3}{4}$ in. At $\frac{1}{2}$ in. from one end, file the arch-shaped hole to the dimensions shown. The length of the opening need not be made to "mike" measurements, but the width of it should not be greater than shown; it must be less than the diameter of the tube, to give the best results. Chuck a bit of $\frac{1}{2}$-in. brass rod in the three-jaw, and turn down about $\frac{1}{2}$ in. of it to a drive fit in the tube; part off two $\frac{1}{8}$-in. slices. One is driven into the end of the tube to plug it; and the other has a tiny segment filed away, to the length of the "sound-hole" and a depth of about 1/32 in., so that when it is driven into the tube, with the filed-away portion level with the "sound-hole" (see section) steam issuing from the curved slot between disc and tube, passes right across the hole.

Chuck the $\frac{1}{2}$-in. rod again, and turn down $\frac{3}{16}$ in. of the end, to a drive-fit in the tube. Centre, and drill down to $\frac{5}{8}$ in. depth with $\frac{1}{8}$-in. or No. 32 drill. Part off at $\frac{11}{16}$ in. from the end; reverse in chuck, face off the pip if any, and slightly chamfer the edge. At $\frac{1}{4}$ in. from the blank end, drill a 7/32-in. hole right through into the blind hole, and tap it $\frac{1}{4}$ in. by 40. In this, fit a union screw, as described for pumps and boiler fittings; this is screwed $\frac{1}{4}$ in. by 40 at both ends.

At about $\frac{7}{16}$ in. from the plugged end of the whistle tube, drill a $\frac{3}{8}$-in. hole, diametrically opposite to the arch-shaped hole. In this, fit a short piece of $\frac{3}{8}$-in. tube, same as used for boiler tubes, or a bit of thin brass treblet tube would do. File off the end, with a round file, so that the tube doesn't project into the whistle tube, and cause obstruction. The other end of the tube is fitted into the hole in one end of the sound-box, the whistle tube fitting tightly against the cover or end plate. All the joints can then be soft soldered. Note, there must not be any air leaks, especially around the short bit of tube connecting the whistle tube to the sound-box. Now, if you blow into the open end of the whistle tube, you should get a faint, rather husky, low note. If the whistle blows easily by lung pressure, it is not suitable for high steam pressure. Push in the spigot of the union fitting, then connect a tyre-pump to the union screw. Press on the handle of the pump, bending any part of the connecting hose almost double, to prevent air passing; then suddenly release it when the gauge of the pump indicates 60 lb. or so. The whistle should then give a clear note. If it doesn't, either there is a leak in the soldered joints, or else the disc at the arch-shaped hole needs adjusting. If O.K. the whistle should blow the very deep L.M.S. note, quite clearly, at 60 lb. pressure. It will not be very loud, as the laws of acoustics (I believe that is the "scientific" term!) won't permit a little whistle to give the same volume of sound, at the same pitch, as a big one; but as you don't have to call a signalman's attention a couple of miles away, or anything of a similar nature, on the average little railway, the absence of a great volume of sound doesn't matter a bean. If you want the sound of the whistle to carry a long way, a small whistle must be made to give a shrill tone. You can't have it all ways! I have seen it stated that the proper way to make the opening is to cut it straight across, and not in the form of an arch at all; all I can say to that, is that the great majority of tube whistles, including the American chime whistles, have arch-shaped openings, and I have found this shape very satisfactory on my own engines.

How to Erect the Whistle

It took only about 15 minutes to erect the whole bag of tricks on "Grosvenor," so it shouldn't take much longer on "Doris." The sound-box was located about halfway between the backhead and drag-beam, with the pipe union pointing to the left. I then took the distance between the union on the whistle and the union on the turret, with a bit of lead fuse wire; cut my pipe, made the two nuts and cones, and silver-soldered the latter to the pipe, softening it at the same time. After pickling, washing off, and rubbing up with a bit of fine steel wool, the pipe was bent to the right contour by finger pressure, and the unions connected up. The pipe held the whistle in place *pro tem.* The piece of footplate between frames, backhead and drag-beam had been temporarily removed, naturally, before locating the whistle; and on this I marked a spot corresponding with the approximate centre of the sound-box, drilled it No. 40 and countersunk it. The footplate was then put in position, and a mark scribed on the top of the sound-box through the hole. The sound-box was then removed, the marked spot drilled No. 48 and tapped 7-B.A.; replaced, union tightened up, footplate replaced "for keeps," and a 7-B.A. countersunk brass screw, with a smear of plumbers' jointing on the thread, put through the hole in the footplate, into the tapped hole in the top of the sound-box.

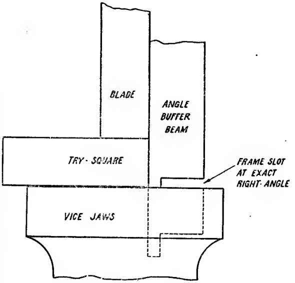
"Doris's" whistle can be erected in a somewhat similar manner, but you can't put it exactly in the same place, as part of that space will be occupied by the steam-brake cylinder, which is attached to the left-hand frame between the drag-beam and the backhead. The best place to put it, will be as close to the right-hand frame as possible, and about $\frac{1}{4}$ in. ahead of the drag-beam. The sound-box can go partly under the top angle of the drag-beam, and the fixing screw can pass through a hole drilled in same; there is no need for the screw to be exactly in the middle of the sound-box. It has very little weight to support; the steam pipe does the lion's share of the holding up. Beginners note—if thin plate is used for the top and bottom of the sound-box, solder a little disc of brass about $\frac{1}{16}$ in. thick and about $\frac{3}{8}$ in. diameter, at the place where the screwhole is drilled and tapped; otherwise there won't be sufficient hold for the thread. Use $\frac{1}{8}$-in. pipe, to connect the whistle union to the one on the turret.

Seat Boxes for "Maid" and "Minx" Cabs

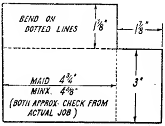
I did not include drawings for the seat boxes in the cabs for the "Maid" and "Minx," because you can get the measurements more easily from the actual job. All you need is a kind of rectangular splasher to cover the trailing wheels where they project into the cab; and these can be made by bending up pieces of sheet metal, cut to the shape shown in the illustration, and bent

at right-angles on the dotted lines. They can be permanently attached to the sides of the cab, by small pieces of angle, either riveted or screwed, just as you prefer.

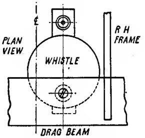
One beginner wanted to know how to get the cab front in place, as the whistle turret prevented it being slid straight into position. If the front is held on the slant, and placed over the whistle turret first, no difficulty should be experienced in getting the lower part over the sides of the firebox, as there are no projecting pipes or other impedimenta, to obstruct its passage; but one of my favourite tricks on my own engines, is to divide the cab front into two pieces, the joint being immediately in front of the whistle turret. Each half is then permanently attached to the corresponding side of the cab, and the seat box also fitted, thus making one unit of the cabside and half the front. The two halves are joined over the boiler by a piece of brass angle, the vertical part of which is riveted to one half, and attached to the other by countersunk screws; the cab roof is screwed down to the horizontal part of the angle. This arrangement was especially suited to "Grosvenor," as the cab front is straight at the top, not curved as usual, and the front part of the cab roof also is flat.



A simple way of cutting true slots in buffer beams



Seat boxes "in the flat"



How to erect the whistle

Beginner's Corner

Many years ago, more than I care to remember, a section of these notes was set aside for the exclusive benefit of raw beginners; I called it the "Tyro's Lobby," and in it described sundry elementary jobs in locomotive-building. These included the construction of a very simple 4-4-0 locomotive in $2\frac{1}{2}$-in. gauge, which I called "Annie Boddie" because anybody could build it. There were a lot of these engines built, and many are still running. Well, from time to time I still receive letters from raw tyros, asking for publication of simple detailed instructions on how to carry out various operations in locomotive construction; so with the kind permission of our friend with the blue pencil, I propose to deal with a few simple jobs, explaining how same can be done without expensive equipment. Remembering the days of my childhood, spent around "Poverty Corner," I have very great sympathy for those whose workshop equipment is of the most primitive kind; but they can take consolation in the fact that it isn't always the owner of the most expensive and elaborate outfit, who turns out the best locomotives!

The Why and Wherefore of Angle Buffer-beams

Now, when your humble servant sets out to design or build a locomotive, the *modus operandi* is exactly the same as that pursued by a full-size Chief Mechanical Engineer. I take into consideration the size of the engine, the work it will be called upon to do, and the probable facilities needed for building it. I aim at making the engine strong, serviceable, easy to build, powerful and efficient; and it is in no sense a "model," a word I hate and detest. Where full-size practice can be copied with advantage, it *is* copied; where better results can be obtained

by departing from "orthodox" methods of construction, these are ruthlessly abandoned. What is suitable for 4-ft. $8\frac{1}{2}$-in. gauge, is very frequently quite unsuited for 5-in., $3\frac{1}{2}$-in. or smaller gauges. My designs are not based on the building of one, two, or even half-a-dozen engines, but by scores; I have a whole fleet here now, for operation on my own little railway. In the days gone by, when I had more time and energy, I carried out any amount of rebuilding and overhauling for various friends and other folk, and thereby became acquainted at first-hand with the shortcomings—and they were many!—of various other designers, especially those who did not build themselves; and in my own engines, I have endeavoured to eliminate the faults discovered. New readers may be interested to know that it is now 60 years since I built my first working locomotive—experience teaches!

A weak point in the design of many engines, is the buffer-beam. In full-size practice it used to be a huge wooden plank or beam, attached to the front of the frames, hence the name. In modern engines it is a steel plate secured to the side frames by angles and gussets. Many of the engines I repaired, had the frames out of square, of rhomboidal form, either by having a "biff" on one corner of the beam, or else being put up incorrectly. In every case, the beam was either a casting with lugs on it to receive the frames, or just a plain strip of metal, secured by angles in imitation of full-size practice.

When I started these notes, some 25 years ago come September, I determined that in any design put forward, all defects that I had discovered should be eliminated; and to provide frames that would be easy to erect squarely, and withstand the shocks of collision, derailment, and other happenings, I started to specify buffer-beams made of angle steel, with the horizontal member slotted out to take the frame plates. Now, brother beginners, just try this little experiment. Put a piece of steel, 1 in. wide, and $\frac{1}{8}$ in. thick, in the jaws of your vice, letting, say, about 2 in. stick out at the side of the jaws. Now hit the projecting part sideways with a hammer; give it a reasonably hefty clout. Bent it pretty badly, haven't you—ah, I thought so! Well, now put a piece of 1-in. by $\frac{1}{8}$-in. angle steel in the vice, gripping by the vertical part of the angle, and letting the horizontal part rest on top of the vice jaws; don't hold that part at all. Now give the end a clout with the hammer, same as you did the flat bar. Doesn't seem to have any effect at all on it, does it? Well, that little experiment will explain, without any words, why I use and specify angle buffer-beams. If an engine with a flat bar beam bumped into anything, even with moderate force, and got all the shock on one corner, or one buffer, the beam would be bent, and the whole frame knocked out of square, no matter how many cross-stays were inserted between the frame plates. Even if the stays were heavy castings, the frame would probably be distorted between the beam and the first and second stays. But if a locomotive with a buffer beam made of angle, hits anything, or even jumps the road and falls cornerwise on a concrete path, the angle withstands all the shock, just the same as the bit of angle in the experiment mentioned above; and the frames remain straight and true.

As an actual example, a locomotive which I built for a friend over 20 years ago, got away with him (he always was a bit of a speed merchant, especially with automobiles) hit the stop-buffers at the end of the track at a speed which he estimated at about 15 miles per hour, completely demolished them, and crashed clean through a feather-board fence. The driver severely bruised his arm and side, as he was sitting on the car the same way as I do; and the smokebox front of the engine was completely stove in, the chimney being knocked backward like the funnel of a destroyer. The angle buffer-beam was undamaged, the frames intact, and the only damage to the cylinders and motion was a bent eccentric-rod. Had the engine been fitted with an ordinary thin plate buffer-beam, she would have probably been so badly knocked "out of plumb" that a complete rebuild with new frames would have been necessary. As it was, a new smokebox put her completely "as-you-were," the bent eccentric-rod being only a couple of minutes' work to correct.

How to Cut True Frame Slots by Hand

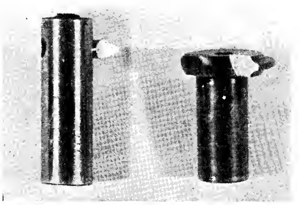
Owners of a milling-machine, planer, or shaper, shouldn't have the slightest difficulty in cutting the slots for the frames dead square with the angles. I always clamp mine back-to-back, set them up in the machine-vice on the table of my milling machine, and cut the slots in both beams at one fell swoop. This ensures that the frames are parallel and square with the beams; they would have some difficulty in being anything else! The same process can be applied when using planer or shaper; set up the beams, clamped back-to-back, in the machine-vice, parallel with the table, or if you prefer, clamp them down to the table. Then cut the slots with a parting tool in the clapper-box. Grind the tool to such a width that it cuts a slot which will be a tight fit for the frames.

I didn't always have a miller, and in the days when my equipment was limited, I cut true slots by hand, in the manner illustrated. Any beginner who hasn't any means of machining the slots, should very carefully mark them out on the angle, then clamp same in the bench vice, setting it at right-angles to the jaws by applying a try-square in the manner shown with the slot level with the jaws. Now, by putting two blades in the hack-saw frame, side by side, and pressing same down on the vice jaws as you cut, a rough but true slot can be formed; and then, by judicious application of a thin flat file such as key-cutters use for forming wards, a slot can be formed to take the frame a tight fit. If the vice jaws are used as a guide for the filing, and the angle has been set vertical by means of a try-square as shown, the slots must of necessity be at right-angles to the beam, therefore the frames will also be true. Personally, I wouldn't give a thank'ee for a frame with plate buffer-beams, no matter how well stayed, because I believe in applying the strength where it can best resist shocks. Slots can be cut in the lathe, too, but I will dea with that method in a future note, if all's well.

*Constructing a Gear-Cutting Machine

by J. S. Eley

THE swinging arm casting is awkward to hold owing to its shape, and the best way to handle it is to use an angle bracket on the lathe faceplate. It could be gripped in a four-jaw chuck, but it would need a pretty hefty one for the jaws to clear the projections of the casting. Clamping the casting on its side to the angle bracket, the projecting spigot is first of all set to run truly and turned down to 1 in. diameter to be a good push fit in the block previously bored to receive it. At the same setting a light cut is taken over the upper surface of the casting concentric with the spigot. A ½-in. hole is also bored and reamed right through the spigot. The faceplate is now replaced by the four-jaw chuck and the casting chucked truly by the projecting part of the bearing housing. Care should be taken to set the casting so that the spigot just machined is square to the centre line of the lathe. This can be checked by sighting with a square off the lathe bed or by the use of calipers between the bed and the machined upper surface of the casting. There is a considerable overhang of the casting in this position and a short stubby drill should be used to start the bore before it is drilled through and bored out to size. A rather long boring tool will be necessary but if light finishing cuts are taken, no trouble should be experienced. Obviously, the actual finish of the bore depends on the facilities available, but every effort should be made to get it as smooth and accurate as possible. If by any chance, access to a honing machine is available, this is the method " par excellence," but failing this, careful lapping is the next best thing. It will be noted that no provision is made for taking up wear. This was considered unnecessary, as the original machine has a ground spindle and a honed bearing and I do not anticipate with the amount of use the machine is likely to have, that it will ever give trouble in that respect. An oil hole is drilled in the projecting part of the bearing housing and tapped about halfway through so that the grub screw tightens up after a few turns. If your skill runs to it, oil grooves can be extended from this hole both ways to within about ¼ in. from each end of the bore. It there is any doubt about it, however, they are best left alone. The outer face of the bearing is still to machine and for this operation it can be mounted on a mandrel. At the same setting the outside of the bearing housing is cleaned up for ⅜ in. as a seating for the reduction gear bracket. Marking out is hardly necessary on this casting, as the centres are unimportant. The main thing is to get the spigot square to, and in the same plane as, the spindle bearing. The finished component can now be fitted to the sliding block and clamped so that the cutter spindle bore is exactly square to the back surface of the sliding block. In this position a ¼-in. hole is drilled and reamed through both components into the ½-in. bore. A knurled-headed locating pin as drawn, is used to lock the two parts together in this position when cutting spur gears and most other jobs. The setting of the swinging arm in an angular position for spiral cutting is done with a protractor.



Home-made single-tooth gear cutters

Cutter Spindles. M.S.

Two spindles are shown, one the normal type of milling machine spindle with screwed nut and spacing collars, the other incorporating a simple chuck for fly-cutters. The screwed spindle is a straightforward turning and screw cutting job from 1¼ in. diameter round steel bar. The bar is cut to length, centred both ends and all work carried out between centres. It is worth the extra trouble to make up a milling machine type nut instead of using a standard ⅝-in. Whitworth nut. No drawings are given for the spacing collars, as these are merely plain sleeves the length of which can be determined after the machine is assembled. The finish of the spindle journal again depends on equipment available, grinding being preferable. For making the other spindle, a sufficient length of bar should be chucked and the journal turned down and

*Continued from page 492, " M.E.," April 21, 1949.

finished. At the same setting, true up the outer diameter af the chuck end. The bar is now cut to length and reversed for turning and boring the chuck portion. If a collet of this size is available, the operation is simplified but failing this, the use of a dial indicator and four-jaw chuck will ensure the bore being concentric with the journal. The bore is blind and should be started with a centre drill, opened out, corrected if necessary and finally finished with a parallel reamer. For securing the cutter shanks, four ¼-in. Whitworth tap holes are drilled radially and tapped for Allen screws. This simple chuck is for holding small Woodruff type cutters with standard ½-in. shanks also the single tooth gear cutters described in the previous article on the machine. As these two spindles must be interchangeable, care should be taken to finish both journals the same size and they can be lapped in together. For securing the driving pulley or driving gear to the spindles, a keyway is the more workmanlike job but a flat on the spindle end to receive a ⅜-in. Allen screw is quite satisfactory in practice. For endwise location of the spindle a steel collar with four $\frac{3}{16}$-in. Whitworth holding screws is used.

Reduction Gear Bracket. M.S.

The speed reduction gears were a later addition to the machine when it was found that a slower speed and increase of power to the cutter was desirable. The bracket itself could be incorporated as part of the swinging arm casting, but it would rather complicate the machining of the part and I think the present arrangement is more practical. The bracket is cut from ½ in. × 1¾ in. mild-steel rectangular bar. The two centres should be carefully marked out as the smooth running of the gears is dependant to a large extent on their accurate location. If toolmakers' buttons are to hand, they can be located by "miking" over the two outer edges of the buttons not forgetting, of course, to deduct half the diameter of each button to arrive at the correct centre distance. Toolmakers' buttons by the way, are very simply made up from ground silver steel stock which is usually within half a thou. of the nominal size. Both holes should be bored in the lathe, setting each bore by button or centre pop as the case may be. Three ¼-in. Whitworth tap holes are located as shown to receive ¼-in. Allen screws. A drill should be run through each hole in turn to make a dimple for the set screws.

Pinion Stud. C.H.M.S.

This stud is a straightforward turning operation. The two screw threads can be either screw cut or threaded with a die in a tailstock holder. As the pinion that revolves on the stud is also of mild-steel, the stud journal should be case-hardened and then polished. This part is made removable so that the driving pulley can be fitted direct to the spindle when required. A knurled steel nut is used for locating the driving pulley and pinion.

Speed Reduction Gears. M.S.

These are cut in steel 20 d.p. The pinion has 20 teeth and the gear 50 teeth giving 2½ : 1 reduction. If a milling machine and dividing head are available there is no difficulty about the job, but failing this, the machine can be used to cut its own gears as was done in my own case. This, of course, will have to be left to a later stage. The pinion is made with an extended boss which is the same diameter as the cutter spindle. The driving pulley can be fitted to either according to whether a direct or gear drive is required. Incidentally the most important function of the gears is to get sufficient power to the cutter without belt slip. The gear is also in steel although cast iron would do if a steel blank of this size is not available. The cutting of both gears is within the capacity of the machine even with a direct drive to the spindle and the set up for this operation is shown in one of the photographs. However, do not expect to be able to cut them with one pass of the cutter. This will be rather a lengthy operation but care and patience exercised at this stage will pay dividends later. The gear wheel bore should really have a keyway slotted into it, but if this appears too formidable a task an Allen screw is the next best thing.

Driving Pulley

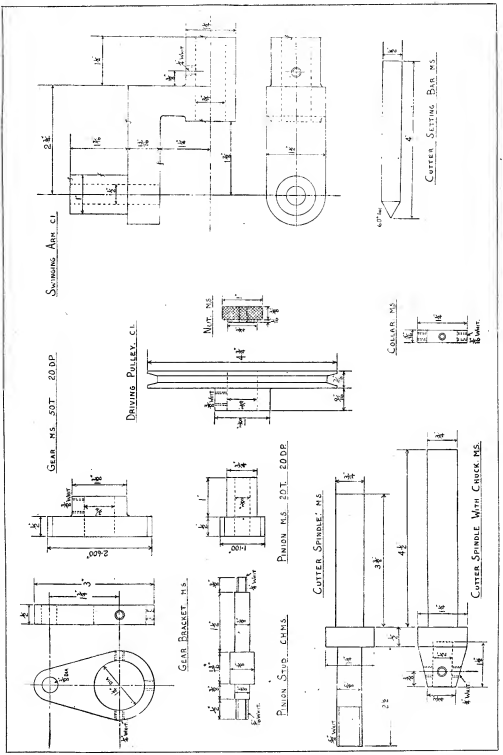
A sketch of the pulley as fitted is given but any suitable pulley casting can be used and there are now on the market several types of die-cast pulley which would do excellently. For direct drive, the pulley is fitted straight on the the end of the cutter spindle. For a geared drive, the pulley is mounted on the extended boss of the pinion which meshes with the larger gear on the cutter spindle.

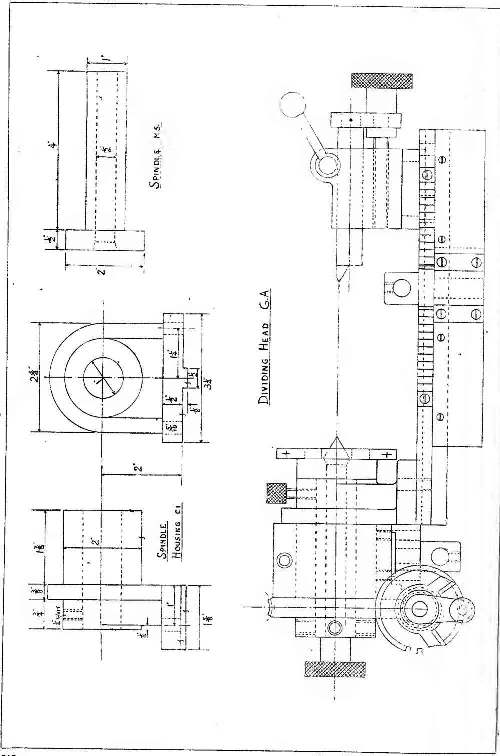
Cutter-setting Bar. M.S.

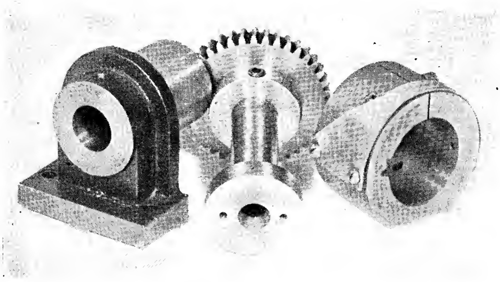
Owing to the fact that a cross-slide has been dispensed with on this machine the cutters are set up each time on the dividing head centre line. This accessory is a length of ½ in. round mild steel bar having one end turned truly down to a 60 deg. cone. In use it is pushed down the ½-in. bore in the swinging arm spigot until it is just above the cutter thus making the centring of the cutter a simple job.

Dividing-head

The dividing-head body consists of an angle bracket casting incorporating a boss, round which the rest of the assembly is rotatable. I think the simplest way of handling this is to chuck the casting truly by the boss and do the internal boring first. Here again the finish should be as accurate and smooth as possible, as the assembly must rotate freely, but at the same time with no shake. At the same setting the front face of the casting is machined up. To machine the outer surface of the boss a 1-in. mandrel is pressed into the bore just finished and the work done between centres. The end surface of the boss is also machined at this setting. This done, the casting is clamped to a "V" block by the boss for marking out the position of the locating tongue and seating surfaces on the base using the machined bore as a datum. It is not necessary to work to very close limits as regards the centre height as this dimension is not critical. The back centre will later be marked off from the dividing head centre when in position. The most important


SWINGING ARM C.I.
CUTTER SETTING BAR M.S.
GEAR M.S. 50T 20DP
DRIVING PULLEY C.I.
NUT M.S.
COLLAR M.S.
GEAR BRACKET M.S.
PINION STUD C.H.M.S.
PINION M.S. 20T 20DP
CUTTER SPINDLE M.S.
CUTTER SPINDLE WITH CHUCK M.S.


SPINDLE M.S.
DIVIDING HEAD G.A
SPINDLE HOUSING C.I.



The dividing-head main components

point is to get the locating tongue on the vertical centre line. For machining the base it can now either be clamped face downwards on the milling machine table or clamped to an angle bracket by a bolt through the bore. The latter way is perhaps the best as it allows the feed to be applied horizontally. The square ended fly-cutter is used again for this operation. The tongue should be machined on the tight side and finally fitted to its groove by scraping. Two $\frac{5}{16}$ in. clear holes are now drilled in the base and corresponding tap holes spotted through into the machine table. The dividing head is located at the extreme end of the table so that the whole of the boss overhangs. A $\frac{1}{4}$-in. Whitworth tap hole is finally drilled and tapped in the position marked, to receive a locking screw.

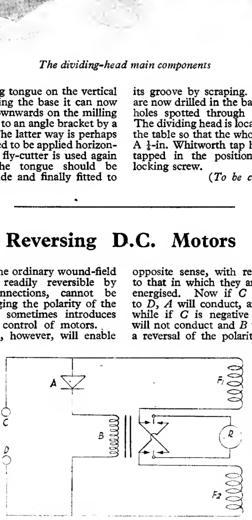
(To be continued)

Reversing D.C. Motors

IT is well-known that the ordinary wound-field d.c. motor, though readily reversible by suitable change of connections, cannot be reversed simply by changing the polarity of the supply circuit, and this sometimes introduces difficulty in the remote control of motors.

The following method, however, will enable such motors to be readily reversed from the supply line.

In the circuit shown, *A* is a small rectifier of the selenium type, *B* is a relay; *F*1 and *F*2 the field coils and *R* the rotor of a d.c. motor. *C* and *D* are the supply input. The contacts of the relay are arranged so that when the relay is energised, the leads to the brushes of the d.c. motor are in the opposite sense, with respect to the field coils, to that in which they are when the relay is not energised. Now if *C* is positive with respect to *D*, *A* will conduct, and *B* will be energised; while if *C* is negative with respect to *D*, *A*, will not conduct and *B* will remain open. Thus a reversal of the polarity of the supply voltage to *C* and *D* will reverse the direction of rotation of the motor. This method can be applied in a similar manner to either shunt or compound-wound motors.



—H. A. DRUETT.

[This simple method of reversing wound-field d.c. motors should be useful to model railway enthusiasts when wound-field traction motors are employed.—ED., " M.E."]

A Double Slide-Valve Design

by J. I. Austen-Walton

WHEREAS we hear and read so much about the generation of steam and perhaps even more about the effect of valve timing on steam consumption, we hear practically nothing about the volumetric losses that are difficult to cure in small steam engines and locomotives.

By volumetric losses, I refer to the large steam passages that lead from the port face to the cylinder itself. The conventional slide valve arrangement has its port group in the centre of the cylinder block, and the passages run to both extremities of the bore.

Although very large, and consequently steam-using passages are not essential for either high-speed or efficient working, this port area is of considerable importance in its function of allowing the expanded and waste steam to escape freely, and without undue pipe friction.

When live steam is admitted to the cylinder, a considerable quantity of steam is left " dead " in the passage, in that it is not a theoretical necessity for the work done in the cylinder itself.

On the exhaust stroke, this " dead " steam is pushed out to waste, before the steam in the cylinder is allowed to escape. In the piston valve system, we do not meet this trouble, for the ports may be spread apart in order to shorten the passages.

The slide valve is still extensively used, and many builders of locomotives who use this type, often go to the trouble of extending the length and general appearance of the steam chest in an effort to simulate the piston valve look.

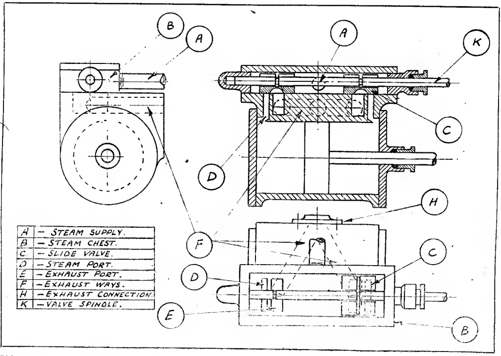
Reference to the drawing shows, diagrammatically, a slide valve head extended in length, but to some real purpose. It will be seen that two slide valves (*C*) are used and driven by one spindle (*K*). The steam ports (*D*) are placed at each end of the bore of the cylinder, and may be so disposed that the job of end-milling the cavity right through, should be quite a simple task, and would provide at the same time a smooth and friction-free passage.

The exhaust ports (*E*) are situated alongside the steam ports, in fairly conventional style, and are connected via drilled passages (*F*) to a common outlet connection (*H*).

It will be noted that the design permits of a long, narrow steam chest (*B*), which in itself is another aid to steam economy, for at least one large gulp of steam every time the regulator is opened, and the steam feedpipe (*A*) has a good entrance, and is not in any way " baffled " by a close proximity to the side face of the slide valve.

The slide valves shown, call for a little comment. It will be seen that the cavity in the valve is in the form of a complete " arch " or part-circle, and this is more efficient than the usual square pocket, for it helps to deflect the steam

(*Continued on page* 523)



Accessories for a Small Lathe

by J. Stebbings

IN a previous article, in the March 17th issue, the methods of carrying out certain improvements to a Super Adept Lathe were described. A description will now be given of the making of a number of accessories which will add to the scope of the little machine, by enabling drilling operations to be carried out and accurate screw-cutting by means of dies.

Countershaft

Whilst a countershaft is not strictly speaking an accessory, it is without doubt a necessary adjunct to a lathe, the provision of which caused the author no little headscratching.

After purchasing a lathe and not wishing to lay out any more money on a finished article (if, indeed, a suitable one could have been obtained), it was necessary to make a countershaft. This would normally require the use of a lathe; but the lathe could not be put into operation without the provision of a countershaft! This vicious circle had to be broken somehow and after trying without success a 1-to-1 drive from a 1,420 r.p.m. motor, it was decided to make a countershaft which did not required any turning operations. The completed article is illustrated in Fig. 1, and it will be seen that it consists of a front cycle hub as the basis, with pulleys made from discs of sheet steel.

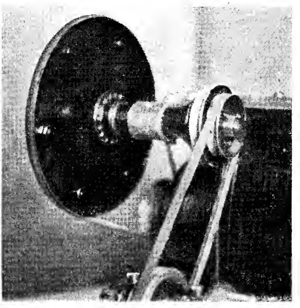


Fig. 1. The completed countershaft

A $1\frac{1}{2}$-in. diameter pulley for a vee belt was purchased to fit the motor spindle and the diameter of the largest countershaft pulley was determined so as to give a speed of 355 r.p.m. The two small pulleys were made to correspond in diameter with the cone on the lathe. This arrangement gives a choice of mandrel speeds of 250 r.p.m. and 500 r.p.m. without the use of a belt-tensioning device. These speeds have been found convenient in practice and are appropriate to the small diameter of work normally turned on a machine of this nature. Leather belting $\frac{1}{4}$ in. diameter was used for the drive from the motor and a Singer sewing machine endless rubber belt was used from the countershaft to the lathe.

The discs for the pulleys were marked out and cut from sheet-metal with the aid of tinsnips, after which the edges were filed truly circular. The rims were formed by the use of the jig illustrated in Fig. 2. A piece of $\frac{1}{2}$-in. thick mild - steel flat was cut off and one end squared up with a file. The centre was pop - marked and the radius (R + $\frac{1}{4}$ in.) was scribed with dividers on the top of the bar. The end was then filed to this curvature.

The radius R was next marked and also a line round the curved end $\frac{1}{8}$ in. from the top. It remained a simple matter to file the splay between these two lines. The jig was completed by the drilling of the hole.

Three jigs were required, one for each size of pulley. The centre hole of each disc was first drilled clearance size for the cycle hub spindle and the disc bolted loosely to the jig. Placing the two parts flat on the bench, the rim was hammered over the jig as shown in Fig. 3. The jig was moved round the disc in steps with slight overlaps until the whole circumference had been bent over. After making another identical disc the two were temporarily bolted at the centre while the holes for the small bolts holding the pair permanently together were drilled. Six holes were required for the large pulley and three for each of the small ones. The discs could quite well be riveted if this method is preferred.

It now remained to assemble the three pulleys on the ends of the cycle hub and at the same time to adjust the cone bearings. A spacing-piece was required between the two small pulleys to bring their rims the requisite distance apart.

The countershaft has proved very satisfactory in service and is very quiet in operation.

Having put the lathe into operation, the need for some means of drilling was immediately

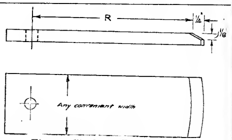


Fig. 2. Jig for pulley rims

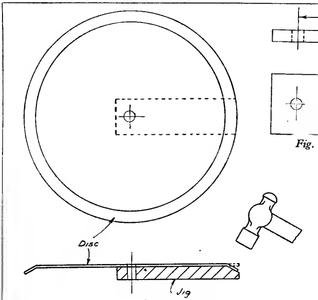


Fig. 3. Forming pulley rims

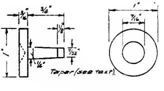


Fig. 4. Drilling pad

felt, and as no drilling machine or tailstock chuck was available, it was decided to make a drilling pad which would at least allow drilling between centres with the drill held stationary by means of a carrier. Also, small articles could be drilled using the pad as a table with the drill held in the chuck.

Drilling Pad

Details of the drilling pad are given in Fig. 4. A length of 1-in. diameter mild-steel was set to run as truly as possible in the 4-jaw chuck and ¾ in. was turned down to ¼ in. diameter. About ⅛ in. of the end was further reduced to 7/32 in. One of the lathe centres was then used as a guide in setting the top slide to turn the necessary taper. This was at first purposely turned at too sharp an angle and, by unscrewing the chuck and trying the work in the taper of the tailstock barrel, was gradually reduced by trial and error until a proper fit was obtained. To avoid the difficulty of parting off a 1-in. diameter bar (the machine's bearings had not yet been improved as described in the previous article) separation was effected by sawing, leaving ample margin for the subsequent facing-up.

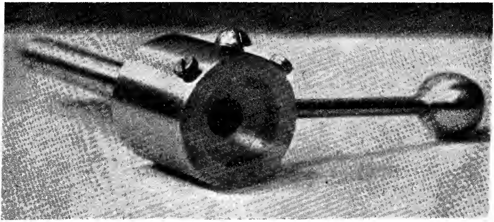


Fig. 5. The completed tailstock dieholder

The work was then placed in the taper of the mandrel nose, the end faced up, and the relief for the drill point bored.

Tailstock Dieholder

This accessory has been designed to hold $\frac{13}{16}$ in. diameter dies, and, as its construction has proved comparatively simple, it is proposed to make another of slightly increased diameter for 1 in. dies. Fig. 5 shows the completed article, and it will be seen to have a long parallel shank which is $\frac{3}{8}$ in. diameter. In use, the tailstock barrel is removed and the dieholder shank substituted. Detailed drawings are given in Fig. 6 and no difficulty should be experienced if the following method is adopted.

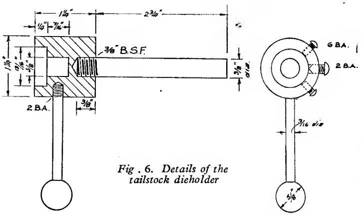


Fig. 6. Details of the tailstock dieholder

Cut a piece of $\frac{3}{8}$-in. diameter silver-steel or bright mild-steel $3\frac{1}{8}$ in. long. Thread one end $\frac{3}{8}$ in. B.S.F. for $\frac{3}{8}$ in. with a hand dieholder, testing the squareness of cutting frequently by means of a try-square. Remove the mandrel from the lathe and substitute the $\frac{3}{8}$-in. diameter bar with its screwed end to the left. Mount the pulley in the usual way in the lathe, face the end of the bar, and cut a centre hole.

Now cut off a $1\frac{1}{4}$-in. length of $1\frac{1}{2}$-in. diameter bright mild-steel and file the ends as nearly square as possible. Set to run truly in the 4-jaw chuck centre, and drill $\frac{5}{16}$ in. diameter for $\frac{3}{8}$ in. Tap $\frac{3}{8}$ in. B.S.F. with the tap supported by the tailstock centre. The chuck will have to be turned by hand for this operation. Remove from chuck, and attach to the shank previously made. It will in all probability be found that the screwcutting has been far from accurate and that the body and shank are not parallel. This, however, need cause no concern and may now be corrected. Mount the shank in place of the mandrel as before with the body still attached and on the right. Face the end of the body and cut a centre hole. Now turn the outside parallel, after which the unit should be removed from the headstock and mounted between centres. The end of the body against the shank may now be faced square. By again mounting the unit in place of the mandrel, the body may be drilled $\frac{3}{8}$ in. diameter and the recess for the die bored out. The holes for the adjusting screws and the handle may be drilled and tapped by hand, and the ball is turned from a piece of $\frac{5}{8}$ in. diameter bar held in the 4-jaw chuck.

A Double Slide-Valve Design

(Continued from page 520)

over from one port to the other without meeting square corners and consequent friction. It is at this point that the exhaust steam meets its one big, but unavoidable obstacle.

Anyone making up this type of head could quite easily make both valves from one block of metal, after drilling through it a central hole, equal to the radius of the valve " arch," and then cutting it in two, facing off each part separately, and letting the depth of machining regulate the surface width of the " arch."

It would entail the fixing of a blank wall end to either or both sides of the valve before completion, and final facing off, but as this is quite a sound method for any type of slide valve, it would not detract from the appearance or working of this particular example.

When designing slide, or D-valves, try to allow for the valve rod to come as low as possible without actually breaking through the exhaust cavity, and make the valve area as small as possible consistent with the needs of lap and valve travel. I have seen dozens of valves made quite unnecessarily wide in the belief that it was important for steam " seal." So it is, with a valve that does *not* seat correctly, but the loading on the motion work, due to the extra area subjected to pressure, goes up enormously, and absorbs useful work done by the engine.

Unfortunately, in the type of valve gear described here, the valve area is increased to some extent. One has always to pay for advantages gained elsewhere, and this is no exception.

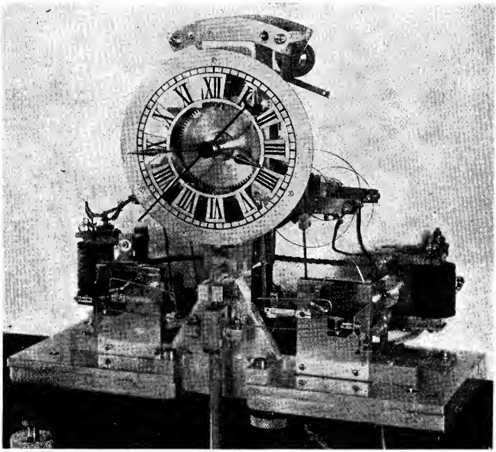
I do feel, however, after certain calculations, and provided always that things like lubrication and correct fittings are maintained, that it is a case of three points lost and five gained, and on that basis might at least be worth fitting.

I might add that it is not an idea for which I claim complete originality, but I have never seen such a system, laid out in a form suitable for the small engine, or locomotive man.

A New (?) Free Pendulum Escapement

by A. R. Turpin

I SUPPOSE one of the most popular clocks amongst amateur horologists is the Congrieve, but this clock has two drawbacks ; first, it is bulky, and second, it is not a very good timekeeper. On the other hand, those perfect timekeepers, like the Synchronome, and similar chapter on " free pendulums," when I came upon the mention of that invented by Capt. E. E. Craig. Now to the uninitiated a free pendulum is one which does no work except receive the impulse which keeps it swinging ; it does not, for instance, release an escapement, or move



The Craig free pendulum clock at South Kensington Science Museum

clocks, lose in fascination because there are no wheels to watch go round when the clock is working ; and it is the number of moving parts in a steam locomotive that makes this type of model so popular.

About twelve months ago I had thoughts of building a clock of some kind, but just at that time I went down with a bad attack of flu. During my convalescence I was reading Mr. Hope-Jones' book on electric clocks, and in particular the ratchet wheel. The Craig free pendulum received its impulse from a steel ball, and the operation is shown in Fig. 1. An arm about 3 in. long is fixed at right-angles to the pendulum as near to the suspension point as possible, and in line with the arc of oscilation.

At the end of this arm is a ramp or sloping platform which, as the pendulum swings, moves up and down in a gap in a runway.

Now if a ball is released as the pendulum has

swung fully to the left, the ball will run down the right-hand runway until it comes to rest against the raised ramp, see " A " Fig. 1. As the pendulum swings to the right, the ramp will drop, and when it is level with the runway the ball will roll over it on to the left-hand runway, and in doing so impart an impulse to the pendulum.

Unfortunately the book said nothing about how the escapement was worked, and as I visit the South Kensington Museum and there I found the Craig clock working merrily away, very much like a couple of experts playing table tennis; the photograph herewith shows the clock in question.

It is extremely well made and very ingenious, somewhat complicated, but is in no way like the escapement I had devised, the cycle of operations of the Craig clock being as follows :

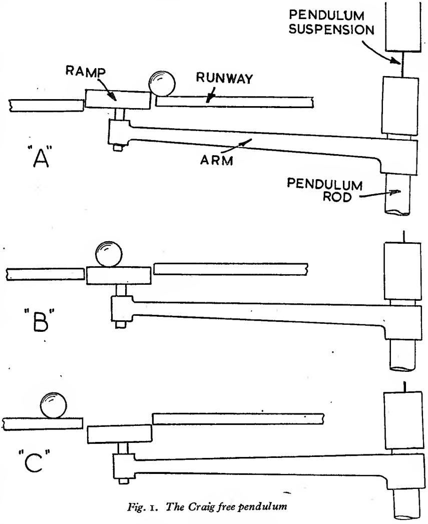


Fig. 1. The Craig free pendulum

lay in bed smoking cigarettes that tasted like burnt rubber, I tried working out in my mind various ways by which the ball could be made to release or operate an escapement; because it will be appreciated that provided the pendulum is regulated so that it swings exactly to a second, then the ball will be released exactly every two seconds. Eventually, I schemed out an idea and wondered if it was the same idea as Capt. Craig had used.

When I was up and about again, I happened to

The pendulum is fitted with two arms, a right and a left.

After the right-hand ball has imparted its impulse to the pendulum it rolls to the back of the clock movement and operates a trigger which allows a mercury switch to tilt over and close its circuit. An electro-magnet operates, and the resultant movement throws the ball upwards to its highest position, and at the same time releases a small catch holding the left-hand ball. This ball rolls a small fraction of an inch forward

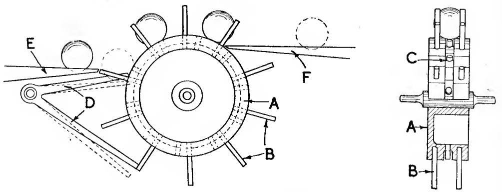


Fig. 2. The escapement

until it rests against the edge of the left-hand pendulum ramp, which is then on its downward travel.

My idea was considerably simpler than Capt. Craig's, and I have been meaning to get down to the construction of it; but somehow I never seem to have the time to do so. So I thought that perhaps some reader might like to experiment with the idea, or point out some obvious fault that would make the whole idea impracticable. I do not suggest that it will be very efficient as regards driving power, but as I proposed to rewind the weights electrically, this is not very important, but if it does work, it should keep very good time, and there will be something to watch go round.

In my idea, only one arm is necessary, and Fig. 2 is a diagrammatical drawing of the escapement. " A " is a brass wheel about one inch in diameter, round the rim of which are two rows of steel pins equally spaced " B ", and in the centre of the rim is a shallow groove in which are ten short steel pins, also equally spaced, " C." " D " is a pallet with two legs, the top one protruding between two of the long pins, and the bottom one resting against a long pin preventing rotation of the wheel. " E " and " F " are the ends of the runway.

The cycle of operations is as follows: After the ball leaves the ramp it rolls down the runway in a semicircle and off the end of the runway " E " between the two pegs opposite, where it bears on the protruding end of the pallet causing it to drop, and with it the bottom leg which unlocks the wheel.

This wheel, being geared to the weight train, revolves in a clockwise direction and a second ball previously deposited rolls on to the runway at " F." Meanwhile, the short pin in the groove lifts the top arm of the pallet back into position so that the bottom arm locks against the next long pin, preventing further rotation of the wheel. The ball just released, rolls round the runway which is at such a slope and of such a length that the ball arrives at the ramp just as it starts its downward travel, and remains at the edge of it until it is level with the runway, when the ball rolls across it, imparting an impulse.

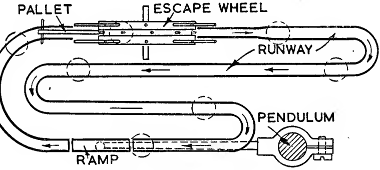


Fig. 3. The general arrangement of the escapement

Fig. 3 shows, diagrammatically, the layout suggested. The runway will have to be arranged so that the ball takes about one and a half seconds to reach the ramp, the remainder of the time being taken up resting and imparting the impulse. It may also be necessary to connect a " fly " to the escapement, otherwise the movement may be too fierce.

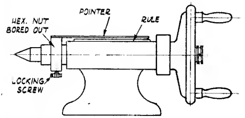
As I have said, I have no idea if it will work, but it should be fun finding out.

PRACTICAL LETTERS

Lathe Tailstock Indexing Dial

DEAR SIR,—The article on the above subject, in your issue of Feburary 17th, 1949, reminds me of a very useful attachment I fitted to the tailstock on my own lathe.

On the body at the top I fitted a small steel rule by two screws, and on the sleeve a collar with a pointer to traverse the rule as the tailstock was screwed out.



This simple gadget proved very useful when making safety valves, clacks, pumps and other locomotive fittings.

The procedure in using this device is as follows: turn the tailstock till the drill touches the work, slide the pointer to zero on the rule and continue boring, watching the pointer for the depth.

Yours faithfully,
Nottingham R. WHOMSLEY.

B.H.P. Tests on Petrol Engines

DEAR SIR,—I wish to challenge the assumption in Mr. R. E. Mitchell's excellent article " B.H.P. Tests on Petrol Engines," February 17th issue, regarding elastic elongation of duralumin holding-down bolts. His conclusions are drawn from the fact that a peak cylinder pressure of 255 lb. per sq. in. will exert sufficient pressure on the holding-down studs to cause an elastic elongation of 0.001 in., thus allowing a serious leakage at the cylinder-head point.

While accepting Mr. Mitchell's figures, might I point out that this would only be true if we assumed that there was no preloading of the holding-down studs, i.e., the nuts were only finger tight. If, however, we assume that the nuts were reasonably tight, we could anticipate a tensile loading of 200-300 lb. on each stud; to be conservative, let us assume the figure is 200 lb., when the total initial cylinder-head joint pressure will be 800 lb. This leaves us a reserve of 800 lb., $\pi \times 0.535^2 \times 255 = 571$ lb., before the studs will start to elongate further. It is, of course, a common fallacy that cylinder pressures increase the stress of holding-down bolts, but this is only true when the total pressure on the cylinder-head, exceeds that of the preloading of the bolts.

The explanation of the leaking cylinder-head joint is to be found in the difference of the coefficients of linear expansion of duralumin and cast-iron, that of duralumin being 14×10^{-6} in. per degree F., while that of cast-iron being 6×10^{-6} in. per deg. F., giving us a difference of 8×10^{-6} in. per degree F. Now with a stud length of 2.5 in. and assuming a temperature rise of 300 deg. F., and, since the engine does not use any form of external cooling other than convection and radiation, the temperature of the studs will be substantially the same as that of the cylinder, we find:—

Differential coefficient of Linear Expansion =

$$8 \times 10^{-6} \times 2.5 \times 300 = 0.006 \text{ in.}$$

and since the initial pre-stressed elastic elongation of each stud under 200 lb. tension =

$$\frac{200 \times 2.5}{\pi \times 0.0675^2 \times 10 \times 10^6} = 0.0035 \text{ in.}$$

it is obvious why the cylinder-head joint leaked. The substitution of a 3 per cent. nickel-steel which has an even lower coefficient of linear expansion than that of the cast-iron cylinder, would provide a positive cure.

Yours faithfully,
Birmingham. T. DALZIEL.

" Twin Sisters "

DEAR SIR,—May I encroach upon the valuable space in this column, to tell readers of THE MODEL ENGINEER, who are following the " Twin Sisters " series, how much I appreciate the many letters received from day to day, all expressing thanks for a new angle on the building of small locomotives.

To me, this is most encouraging, especially as I have barely started on a journalistic career, and it gives me a definite assurance for the future. Now that I know the feelings of a large number of locomotive-building men, I feel like making plans for something even better than the present series.

Since the " Twin Sisters " came into being, I have given one or two lectures to neighbouring societies, on the subject of locomotive construction, and with each presentation the response has been quite staggering.

At the moment, I am answering all letters individually, but, in certain circumstances readers will understand slight delays in getting their replies, especially where technical points are raised.

Already I have had a few letters, pointing out minor mistakes in some of the dimensions given. So far, these mistakes do not add up to much—not enough to affect the working or even the appearance of the job. I hope everyone will appreciate that mistakes are a human frailty, and I claim no exception. At least, I will promise not to draw the engine with both cylinders on one side, or the dome where the chimney should be; no doubt, the day will come when I really shall drop a brick—a great big one, and then—as my journalist friend has warned me—" The skies will open, and there will descend upon you enough building material to put up a block of flats." I think he is right.

Yours faithfully,
Worthing. J. I. AUSTEN-WALTON.